

RESTOCKING MUGGER CROCODILE *CROCODYLUS PALUSTRIS* (LESSON) IN ANDHRA PRADESH: EVALUATION OF A PILOT RELEASE¹

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(With two plates and three text-figures)

Four years' monitoring results of a pilot mugger crocodile release carried out at Ethipothalla falls in Andhra Pradesh indicated excellent survival and growth and very little movement in the wild. The methodology of planning and carrying out a crocodile restocking programme together with the monitoring methods evolved during a four years' observation period are reported. The success of this pilot release programme provided the background for further large-scale releases in the State of Andhra Pradesh. First ever breeding of these released mugger took place in 1981.

INTRODUCTION

The Indian mugger (*Crocodylus palustris*) was considered to be a depleted species by Gee (1964), Misra (1970), Daniel (1970), Biswas (1970), Mukherjee (1974), Bustard (1974) and Shahi (1977). Naturally, the degree of depletion shows considerable regional variation in a country of the size of India. The Government of India Crocodile Project, following the advice of Bustard (FAO 1974), aimed to quickly rehabilitate India's three species of crocodilians by active management—collection of wild laid eggs for safe hatchery incubation and subsequent rearing of the young to a size of 1.20 m before restocking them in selected, well-protected areas of the natural habitat.

In 1976, the Andhra Pradesh Forest Department initiated a State Crocodile Project in association with the Government of India Project Crocodile Breeding and Management, receiving technical assistance from FAO/UNDP.

Detailed surveys carried out in the two major river systems of Andhra Pradesh (the Krishna

and Godavari) and in the State's numerous reservoirs, during the winter of 1976/1977 indicated that the total population of mugger crocodiles in Andhra Pradesh was extremely small. Only six breeding females were recorded in the entire State and the total population estimate was 30 individuals of above 1.0-1.5m (Choudhury, in prepn.).

Clearly, the mugger was critically endangered in Andhra Pradesh. It was, therefore, considered essential to restock mugger in suitable habitat areas in the State which could be given adequate protection by gazetting them as sanctuaries, in order to build up natural breeding groups. This restocking would be carried out using project hatched and reared juveniles.

Bustard (FAO 1974), after examining several mugger habitats in Andhra Pradesh, had recommended the large pool and associated portion of the Chandravanka River, a tributary of the Krishna river immediately below the Ethipothalla waterfalls (Fig. 1), as an ideal area for pilot restocking purposes. Ethipothalla falls now lies in the easternmost limits of the Nagarjunasagar-Srisailem (Krishna) Sanctuary declared and gazetted through the Crocodile Project in June 1978. The sanctuary covers an area of 3600 sq. km. including much excellent mugger and tiger habitat. Bustard

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pointed out that Ethipothalla was a natural mugger habitat and recommended restocking using captive-reared juveniles from Nehru Zoological Park, Hyderabad, where a number of individuals of Andhra Pradesh stock were currently being reared. He also recommended a number of management objectives for the area. These included posting of guards to prevent people from going down to the falls, [both the falls and the crocodiles could be viewed from the top of the falls (FAO 1974)], and to prevent cattle grazing and cutting of grass and other disturbances in the river-bed below the falls. These proposals were accepted by the Government of Andhra Pradesh and the first release in Andhra Pradesh, which was also the first release of captive-reared mugger in Asia, took place at Ethipothalla falls on 8th February, 1977 at which time the guards were posted.

Subsequent releases, each of two individuals, took place on 23-12-78 and 16-9-1980 respectively.

In order to evaluate the success of this pilot release, on which further releases in the State would be based, detailed monitoring of the released mugger was devised in order to collect data on their survival, growth and movement in the wild. This paper sets out this methodology and presents results obtained over the last four years.⁴

RESTOCKING

The pilot restocking of mugger crocodiles in Andhra Pradesh required the following action to be taken :

1. Selection of :
 - (a) a release site
 - (b) the best time for release
 - (c) crocodiles to be released.

⁴ Following this, a further 176 mugger have been released into three wild life sanctuaries in Andhra Pradesh.

2. Pre-release check on the habitat to decide immediate action required.
3. Marking crocodiles for release.
4. Transporting crocodiles to the release site.
5. Actual release.

1 (a). *Selection of the release site*

Ethipothalla was chosen as the first release site on the basis of the recommendation made by Bustard (FAO 1974) specifically :

- (a) The area was formerly a mugger habitat holding a good mugger population until the early 1960's.
- (b) By 1977, the site was still ideal as a mugger habitat—in addition to the main pool immediately below the falls, there are ten other pools up to 5 m deep in a 3 km stretch of the Chandravanka river before joining the Krishna river 5 km below Ethipothalla falls. (Plate 1). These deep pools provide abundant perennial water. There is a good fish population in the pools. This fish population in the pools and small mammals from the surrounding jungle, provide food for the crocodiles.

The cessation of fishing activity under the management regime would ensure that the food resources would be available only for the crocodiles.

Additional advantages of this site for a pilot release of its kind were :

- (a) a manageable small area for protection, from below the falls to the Krishna river confluence—a distance of 5 km. The ideal mugger habitat extended over approximately 3 km and, therefore, was easier to monitor closely.
- (b) Since there were no existing mugger at the time of release all observed mugger

could be positively identified as released individuals without the need to check for marking.

(c) The waterfall and crocodiles can be viewed easily from the top of the falls by research/wildlife staff and by visitors alike, with minimum disturbance.

1 (b). *Release time*

The chosen release site experiences the southwest monsoon from June to September. During this time the waterfall is usually in flood inundating the banks. The monsoon flow, combined with release of surplus water from the right bank canal of the Nagarjunasagar reservoir into the Chandravanka river (Fig. 1) keeps the waterfall discharge high up to De-

cember-January (Plate 1). Therefore, from July to December, the waterfall is usually under heavy discharge depending on rainfall and surplus water release. For the rest of the year (January to end of June) there is a modest water flow over the waterfall (Plate 2). This low water period also coincides with the nesting season of mugger which is March to April in this region.

Early February was considered the best time for release in order to give the captive-reared crocodiles a four month period to settle down and get acquainted with the habitat before the onset of monsoon and resultant floods. Meanwhile, during this dry period, the released crocodiles could be monitored easily and on the basis of these data, a broad, clear-cut monitoring programme could be formulated.

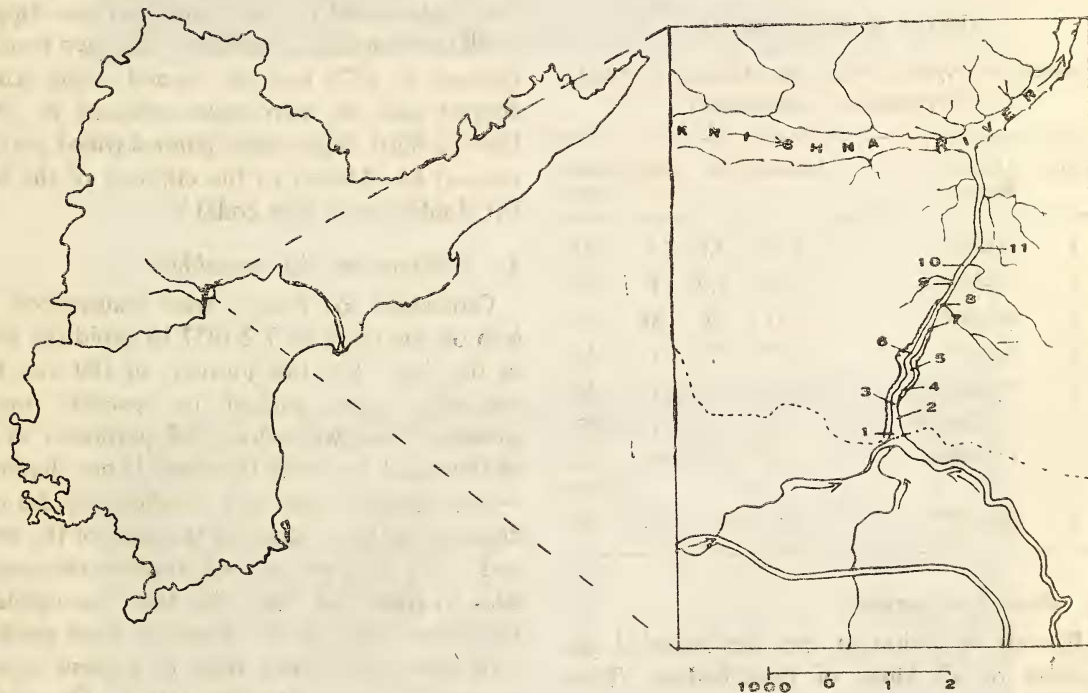


Fig. 1. Andhra Pradesh, showing the location of Nagarjunasagar Wild Life Sanctuary and inset showing the portion of the Sanctuary including Ethipothalla water falls on the Chandravanka River. The pools referred to in the text are numbered. Pool 1 is located immediately below the falls. Scale of inset in metres.

1 (c). *Selection of crocodiles for release*

At this time, Nehru Zoological Park, Hyderabad was rearing twelve wild caught juvenile mugger crocodiles—all caught in the nets of fishermen in the Krishna and Godavari rivers within the State. Four mugger, all above 1 m in size (Table 1) were chosen for release since it was considered that at this size crocodiles are capable of defending themselves. The group consisted of one male and three females. Subsequently, two more female mugger of 1975 year class, taken over from Nagarjunasagar P.W.D. were released and a further selection of two more males for release was made from the Nehru Zoological Park's collection (Table 1).

TABLE 1
DETAILS OF MUGGER RELEASED.

| S.No. | Date of Release | Length | Wt. | Sex | Approx. Age |
|-------|-----------------|--------|------|-----|-------------|
| 1 | 8-2-1977 | 1.08 | 5.0 | F | 32 |
| 2 | 8-2-1977 | 1.09 | 6.0 | F | 32 |
| 3 | 8-2-1977 | 1.11 | 6.0 | M | 32 |
| 4 | 8-2-1977 | 1.17 | 7.5 | F | 32 |
| 5 | 23-12-1978 | 1.52 | .. | F | 42 |
| 6 | 23-12-1978 | 1.63 | .. | F | 42 |
| 7 | 16-9-1980 | 1.90 | 22.5 | M | not known |
| 8 | 16-9-1980 | 1.63 | 18.0 | M | 69 |

2. *Pre-release actions*

Pre-release action at the site included prevention of all kinds of disturbances. These were :

- (a) a ban on cattle and goat grazing below and near the fall and along the river banks.

- (b) a ban on fishing of any kind in the habitat combined with a general ban on the use of the main pool below the fall for recreational purposes, like swimming and bathing etc. This was considered essential in order to avoid conflict between the crocodiles and people.

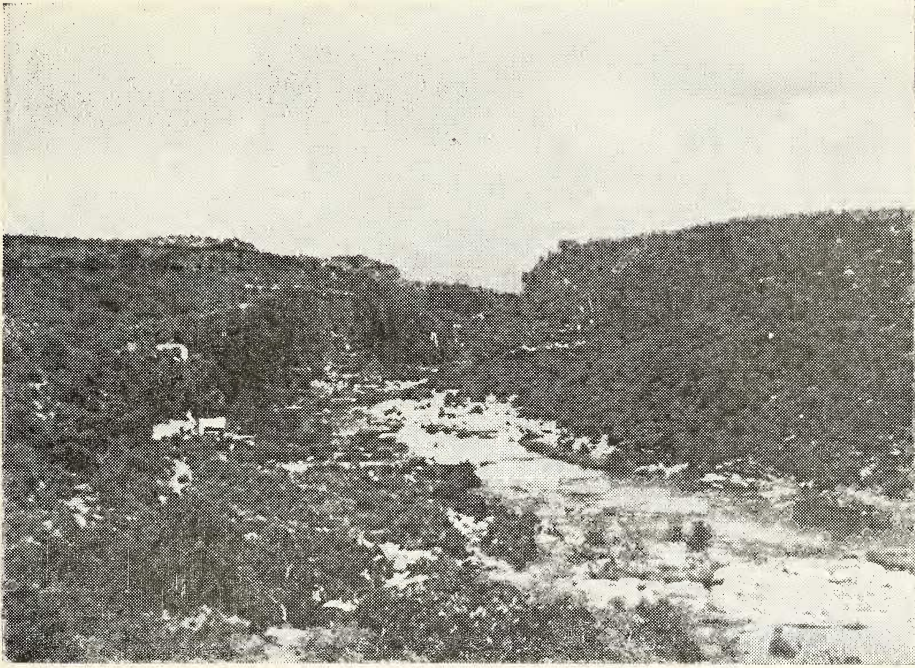
3. *Marking crocodiles for release*

Prior to release, the crocodiles were measured, sexed and marked for future identification. The marking method adopted was clipping of the enlarged scutes on the dorsal caudal region (Fig. 2). Males were clipped by removal (Plate 2) of the last left double caudal scute, looking at the animal from tail to head. No scute was clipped to indicate female sex. For the first year of release (1977), the first scute of the single scuted portion of the tail was clipped in all four released crocodiles. The two females released in 1978 had the second single scutes clipped and the two males released in 1980 had the third single scutes clipped (third year of release) in addition to the clipping of the last left double scute (sex code).⁵

4. *Transporting the crocodiles*

Crocodiles for release were transported by jeep on the night of 7-2-1977 to avoid the heat of the day. For this journey, of 180 km, the crocodiles were packed in specially made wooden crates with elongated partitions so as to allow each crocodile to remain in one chamber—each chamber was well ventilated by 2.5 cm diameter air holes made on the sides of the box, and had a door on one end to allow the crocodiles to come out when the door was opened. The inner walls of the chambers were padded with straw and gunny bags to prevent injury to crocodiles during transportation. On reach-

⁵ For details concerning the marking of crocodilians for release, see Bustard, H. R. and Choudhury, B. C. (1981).



Mugger habitat on the Chandravanka river below the Ethipothalla waterfall with a succession of rapids interspersed with deep pools.



Ethipothalla falls—monsoon level of water discharge.
(Photos : H. R. Bustard)



Ethipothalla falls during the lean season showing modest water discharge.



Clipping the second of the single scutes to identify year of release.
(Photos ; H. R. Bustard)

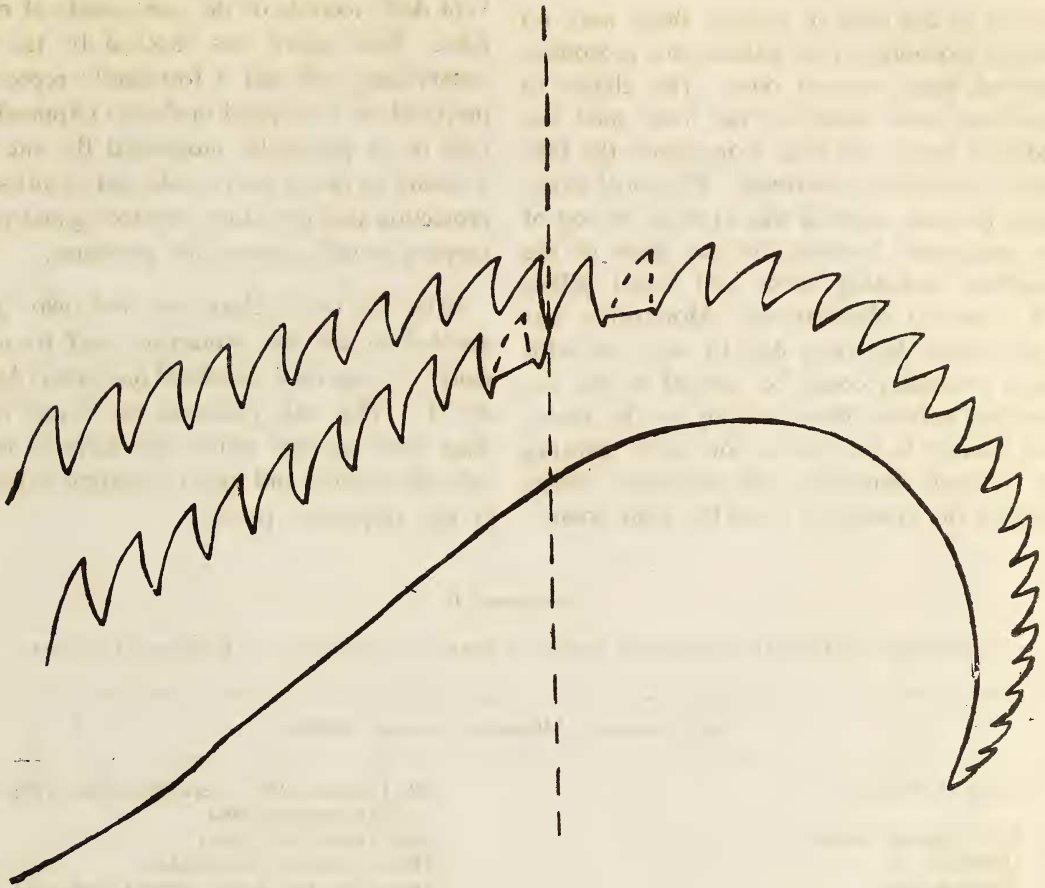


Fig. 2. Crocodile tail showing arrangement of double and single scutes. The dotted lines show the division between these. The last of the double scutes on the left hand side has been clipped denoting that the individual is a male. The second of the single scutes has also been clipped denoting year two release. In both cases the dotted portion of the scutes has been removed.

ing the destination, the crocodiles were kept in the shade well moistened until the release time.

5. Actual release

The initial release took place at 1700 hours on 8-2-1977. The crates containing the crocodiles were taken down to the main pool below the falls and kept with their door end facing

the water. On opening the door of the crates, the crocodiles faced the water, and could come out of the box on to the bank of the pool. The time taken for the crocodiles to emerge varied from five to fifteen minutes.

Further releases of two female mugger on 23-12-1978 and two males on 16-9-1980 were carried out at the same spot.

MONITORING

Since at the time of release, there were no resident crocodiles in the habitat, any crocodiles observed were released ones. The ability to view four pools including the main pool immediately below the falls, from above the falls greatly facilitated monitoring. The usual monitoring practice adopted was to walk on top of the escarpment looking for any signs of the crocodiles including spoor and faecal pellets and recording observations. Monitoring was done during day time due to the ease with which crocodiles could be spotted in the undisturbed habitat often basking on the rocks. This habitat is not suited for night spotting due to many boulders and vegetation which obscured the crocodiles from the light source.

The guards appointed at the site for protection kept daily records of the movements of crocodiles. This record was checked by the local supervising staff and a fortnightly report was prepared on a supplied proforma (Appendix I). One of us personally monitored the site once a month to check the records and to advise the protection staff on future monitoring and record keeping as well as protection problems.

After the third release on 16-9-1980, it was decided to use the protection staff to record daily sightings on a simplified proforma (Appendix II). This only indicated the names of the deep pools against which they have to record only the number and time of sighting crocodiles in the respective pools.

APPENDIX I

FORTNIGHTLY/MONTHLY MONITORING REPORT OF RELEASED CROCODILES AT ETHIPOTHALLA FALLS

Species released—Mugger (*Crocodylus palustris*)

| | |
|--------------------------|---|
| 1. Dates of release | .. 8th February 1977, 23rd December 1978 and 16th September 1980 |
| 2. Total number released | .. Eight (four+two+two) |
| 3. Details of sex | .. Three males and five females |
| 4. Marking codes | .. Males last left double caudal scute and first or third single caudal scutes clipped. Females first or second single caudal scutes clipped. |

To be filled in by the Observer

| | |
|--|-----------------------|
| 1. Date of Observation | .. |
| 2. Water level in the fall | .. Low/Moderate/High |
| 3. Weather condition | .. Sunny/Cloudy/Rainy |
| 4. Air temperature | .. |
| 5. Water temperature | .. |
| 6. Crocodiles observed (number, location etc.) | .. |
| 7. Average basking time of crocodiles for the day | .. |
| 8. Information on observations by local watchmen during last fortnight/month | .. |
| 9. Remarks/Suggestions of the observer | .. |

Date :

Signature of the observer

Name in full :

RESULTS

The results set out below are grouped under three headings ; survival, movement and growth.

Survival

The total number of crocodiles observed on each monitoring trip by one of us (BCC) is given in Table 2. Table 3 gives the crocodiles sighted by the supervisory staff in each monitoring trip, and in Table 4 the daily records of the local protection staff are set out for the month of January 1981. Combining the data from the three Tables, a clear picture of the survival of released mugger can be obtained. The supervisory monitoring and the research monitoring visits were mostly of one day's duration and allowed a maximum 5-6 hours observation at the release site. On the last 6 visits by us, the actual monitoring time has been reduced to 2-3 hours per visit. Despite the brief duration of these visits, it can be clearly seen from Table 2 that the 1977 released crocodiles were resighted regularly following the release. That all survived after rehabilitation to the wild from zoo life is apparent from the monitoring result of 8 February 1978 (a full year after release), when all four were again resighted. One year later (on 13 March 1979) five of the (then) six released crocodiles were resighted. Following release of a further two individuals on 16-9-1980 the maximum number sighted has been seven.

The monitoring data of the local staff is more complete (Table 4), with 5 individuals seen on a single day (January 3, 1981) and on several observations six individuals have been observed (Fig. 3). On 17th May 1981 the local staff sighted 7 (of the 8) crocodiles. Since the local protection staff were present most of the time and operate from both ends of the habitat, their monitoring was more complete and they have sighted seven out of eight crocodiles so far.

Though all the eight mugger released have never been observed on any one day, it is believed that the survival has been 100% and that all mugger have not been observed because attempts to cover the whole area on a single day for a longer observation period have not been made. Pending this, it can be definitely stated that seven out of the eight mugger have survived.

Movement

Taking the 1977 release first, it can be seen that extremely little movement occurred in the year following release. Two mugger showed movement of within 100 m, one moved 500 m downstream and returned to pool 1 and one female moved a distance of 800 m and took up residence in pool 5. One individual of the second release (December 1978) has been sighted in pool 11 at a distance of 3 km below the release site from September 1980, and the sighting of most, if not all, crocodiles on each monitoring trip provided clear evidence that movement out of the area had not taken place. With improvement of the monitoring work and further releases over the years, all areas below the falls have been mapped and their distance from the main release pool measured. Since the mugger cannot move upstream due to the high falls, movement only took place in one direction—downstream. The data indicate how far mugger crocodiles move downstream, either voluntarily or due to effect of monsoon floods. As has been described above, the release site consists of a series of deep pools and for our monitoring purpose, 11 pools have been mapped. The last pool is located at a distance of 3 km below the fall. The nearest pool to the main pool is only 50 m distant. All movements were restricted to this 3 km stretch even allowing for four monsoon floods (the 1977 monsoon following the first release was the worst in living memory extensively flooding the area.)

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TABLE 2

MONITORING RESULTS OF RESEARCH STAFF. THE DISTANCE MOVED BY CROCODILES WHICH HAD
MOVED DOWNSTREAM FROM THE MAIN POOL IS GIVEN IN METRES IN BRACKETS

| Date | Total Number of crocodiles seen | Main Pool | Distance below main pool |
|-----------------------------|------------------------------------|-----------|-----------------------------|
| 1 | 2 | 3 | 4 |
| 1977 | | | |
| 25th March ¹ | 4 | 2 | 2 (100) |
| 22nd April | 3 | 2 | 1 (100) |
| 17th May | 4 | 2 | 1 (100), 1(50) |
| 8th June | 4 | 3 | 1 (300) |
| 3rd July | 3 | 2 | 1 (100) |
| 8th August | 3 | 2 | 1 (100) |
| 9th October | 4 | 2 | 2 (50) |
| 23rd November | .. | .. | .. |
| 14th December | 2 | .. | 1 (100), 1(500) |
| 1978 | | | |
| 28th January | 2 | 2 | .. |
| 8th February | 4 | 3 | 1(800) |
| 30th March | 2 | 2 | .. |
| 28th April | 3 | 3 | .. |
| 28th May | 3 | 3 | .. |
| 14th June | 3 | 3 | .. |
| 6th September | 3 | 3 | .. |
| 23rd December ² | 4 | 2 | 1 (500), 1 (200) |
| 1979 | | | |
| 13th March | 5 | 4 | 1 (50) |
| 3rd April | 3 | 3 | .. |
| 11th August | 2 | 2 | .. |
| 17th November | 2 | 2 | .. |
| 1980 | | | |
| 13th January | 3 | 2 | 1 (500) |
| 21st February | 3 | 3 | .. |
| 3rd May | 4 | 2 | 1 (400), 1 (100) |
| 15th June | 3 | 2 | 1 (400) |
| 17th September ³ | 2 | 1 | 1 (200) |
| 9th November | 3 | 1 | 1 (100), 1(800) |
| 1981 | | | |
| 27th January | 3 | 2 | 1 (500) |
| 27th February | 3 | 3 | .. |

¹ Four crocodiles released.

² Two additional crocodiles released on 23-12-1978 increasing the total population to six individuals. On this date monitoring was carried out *prior* to this release and all four individuals sighted.

³ Two additional crocodiles released on 16-11-80 increasing the total to 8.

TABLE 3

MONITORING RESULTS OF LOCAL SUPERVISORY WILD LIFE STAFF, CONDUCTED AT APPROXIMATELY FORTNIGHTLY INTERVALS, COVERING THE PERIOD 28 DECEMBER 1977 TO 1 SEPTEMBER 1980. THE DISTANCE MOVED BY CROCODILES WHICH HAD MOVED DOWNSTREAM FROM THE MAIN POOL IS GIVEN IN METRES IN BRACKETS

| Date | Total number of crocodiles seen | Main Pool | Distance below main pool | Waterflow |
|------------------|---------------------------------|-----------|--------------------------|-----------|
| 1977 | | | | |
| 28th December | .. | .. | .. | Moderate |
| 1978 | | | | |
| 5th February .. | .. | .. | .. | Moderate |
| 9th March .. | 2 | 2 | | Moderate |
| 21st May .. | 1 | 1 | | Low |
| 24th May .. | 2 | 2 | | Low |
| 14th June .. | 3 | 2 | 1 (500) | Moderate |
| 11th August .. | 3 | 3 | | Full |
| 25th August .. | 2 | 2 | 1 (500), 1 (100) | Full |
| 22nd December .. | 4 | 2 | | |
| 1979 | | | | |
| 6th January .. | 4 | 3 | 1(500) | Moderate |
| 18th January .. | 3 | 3 | | Moderate |
| 28th January .. | 3 | 3 | | Low |
| 3rd February .. | 2 | 2 | | Low |
| 11th February .. | 4 | 4 | | Low |
| 18th February .. | 2 | 2 | | Low |
| 9th April .. | 2 | 2 | | Low |
| 16th April .. | 4 | 4 | | Low |
| 23rd April .. | 5 | 3 | 2 (600) | Low |
| 6th May .. | 3 | 3 | | Low |
| 13th May .. | 3 | 1 | 2 (600) | Low |
| 20th May .. | 5 | 3 | 2 (600) | Low |
| 27th May .. | 2 | 2 | | Low |
| 3rd June .. | 4 | 2 | 2 (600) | Low |
| 12th June .. | 5 | 3 | 2 (600) | Low |
| 24th June .. | 2 | 2 | | Low |
| 10th July .. | 3 | 3 | | Low |
| 22nd July .. | 4 | 4 | | Low |
| 5th August .. | 4 | 4 | | Low |
| 12th August .. | 3 | 3 | | Low |
| 28th August .. | 2 | 2 | | Low |
| 11th September | 1 | 1 | | Full |
| 23rd September | 2 | 2 | | Full |
| 7th October .. | 3 | 3 | | Moderate |
| 14th October .. | 3 | 3 | | Moderate |
| 21st October .. | 1 | 1 | | Moderate |
| 28th October .. | 2 | 2 | | Moderate |
| 4th November | 2 | 2 | | Moderate |
| 19th November | 2 | 2 | | Moderate |
| 2nd December | 3 | 3 | | Moderate |

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| Date | Total Number of crocodiles seen | Main Pool | Distance below main pool | Waterflow |
|------------------|---------------------------------|-----------|--------------------------|-----------|
| 1980 | | | | |
| 1st January .. | 2 | 2 | | Moderate |
| 16th January .. | 3 | 3 | | Moderate |
| 1st February .. | 3 | 3 | | Moderate |
| 16th February .. | 2 | 2 | | Moderate |
| 2nd March .. | 2 | 2 | | Moderate |
| 16th March .. | 2 | 2 | | Low |
| 1st April .. | 2 | 2 | | Low |
| 16th April .. | 2 | 2 | | Low |
| 1st May .. | 2 | 2 | | Low |
| 16th May .. | 2 | 2 | | Low |
| 1st June .. | 2 | 2 | | Low |
| 16th June .. | 3 | 2 | 1 (100) | Low |
| 1st July .. | 2 | 2 | | Low |
| 16th July .. | 2 | 2 | | .. |
| 1st August .. | 2 | 2 | | .. |
| 16th August .. | 2 | 2 | | .. |
| 1st September .. | 2 | 2 | | .. |

Growth

At the time of the first release of four mugger of estimated age 2 years 8 months, on 8th February, 1977, the average size was 1.11 m (Table 1). At the time of the second release of two mugger estimated to be three and a half years old, on 23rd December, 1978 (22 months after the first release), a footprint of the first released mugger was measured and from this it was estimated that the size of the mugger was 1.6 m (the possible error of estimation at this size is ± 5 cm). This indicated a growth rate of about 50 cm in 22 months by which time the mugger were approximately four and a half years old.

Thereafter, no further footprints have been measured, and size estimation has been carried out visually. On the day of the third release on 16th September 1980, (22 months after second release) the resident mugger were almost identical with the 1.9 m male released on that day. The growth rate, therefore, during the next 22 months, by which time the mugger were about six and a half years old, was about

30 cm. An overall growth of 80 cm, was recorded in 44 months, in the wild, for mugger between the approximate ages of two and a half years and six and a half years.

Breeding

The first wild breeding of these released mugger took place in 1981. The female, from the second release, which bred, was in her seventh year. A full account of this will be published in due course.

DISCUSSION

The importance of selecting an ideal release site cannot be overstressed. If this is wrongly chosen the release is doomed to failure. In order to give the released crocodilians every opportunity to adjust to and become acquainted with their new surroundings, prior to the onset of the monsoon, the release season is also of key importance. Crocodiles should be released in the early spring, at least three months prior to the commencement of the monsoon.

TABLE 4

MONITORING RESULTS BY THE LOCAL PROTECTION STAFF ON A DAILY BASIS. THESE RESULTS ARE GIVEN FOR JANUARY 1981 FOR COMPARISON WITH THE DATA IN TABLE 2. AN ASTERISK (S) INDICATE(S) THE SIGHTING OF A CROCODILE(S), THE TIME OF SIGHTING IS ALSO GIVEN. THE LOCATION REFERENCES ARE GIVEN IN THE TEXT AND IN

FIGURE 1

| Date (Jan. 1981) | Main Pool | Location | | | | | | | | | | | Total seen |
|---------------------|--------------|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|---------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | |
| 1 | .. **1545 | .. | .. | *0900 | .. | .. | .. | .. | *1200 | .. | .. | 4 | |
| 2 | .. *0930 | .. | .. | .. | .. | .. | *1200 | .. | .. | .. | *1600 | 3 | |
| 3 | .. *0900 | .. | .. | *0945 | .. | .. | *1200 | .. | *1400 | .. | *1600 | 5 | |
| 4 | .. *0900 | .. | .. | *1000 | .. | .. | *1330 | .. | .. | .. | *1600 | 4 | |
| 5 | .. *0930 | .. | .. | *1100 | .. | .. | .. | .. | .. | .. | .. | 2 | |
| 6 | .. *1000 | .. | .. | *1030 | .. | .. | .. | .. | .. | .. | *1545 | 3 | |
| 7 | .. *0900 | .. | .. | .. | .. | .. | *1100 | .. | *1500 | .. | .. | 3 | |
| 8 | .. *0930 | .. | .. | .. | .. | .. | *1200 | *1230 | .. | .. | .. | 3 | |
| 9 | | .. | .. | .. | .. | .. | *1400 | .. | .. | .. | *1600 | 2 | |
| 10 | .. **0945 | .. | .. | *1030 | .. | .. | .. | .. | .. | .. | *1600 | 4 | |
| 11 | .. *0900 | .. | .. | *1000 | .. | .. | .. | .. | .. | .. | .. | 2 | |
| 12 | .. **1100 | .. | .. | *0930 | .. | .. | .. | *1500 | .. | .. | .. | 4 | |
| 13 | .. **1545 | .. | .. | *1000 | .. | .. | .. | .. | .. | .. | *1600 | 3 | |
| 14 | .. *1000 | .. | *1500 | .. | .. | .. | .. | .. | .. | *1530 | .. | 4 | |
| 15 | .. **1230 | .. | *1600 | .. | .. | .. | .. | .. | .. | .. | .. | 3 | |
| 16 | .. **1600 | *1530 | .. | *1000 | .. | .. | .. | .. | .. | .. | .. | 4 | |
| 17 | .. **1045 | .. | *1200 | *1400 | .. | .. | .. | .. | .. | .. | .. | 4 | |
| 18 | .. **1100 | .. | .. | *1230 | .. | *1400 | .. | *1500 | *1630 | .. | .. | 6 | |
| 19 | .. *0900 | .. | .. | .. | *1100 | .. | *1300 | .. | .. | .. | *1600 | 4 | |
| 20 | .. **1200 | .. | .. | *1430 | .. | .. | .. | .. | *1500 | .. | .. | 4 | |
| 21 | .. **0800 | .. | .. | *1000 | .. | .. | *1200 | .. | .. | .. | .. | 4 | |
| 22 | .. *0930 | .. | .. | *1100 | .. | .. | .. | .. | *1400 | .. | .. | 3 | |
| 23 | .. *1000 | .. | .. | .. | .. | *1400 | .. | .. | .. | .. | *1600 | 3 | |
| 24 | .. **1130 | .. | .. | *1230 | .. | .. | .. | .. | *1630 | .. | .. | 4 | |
| 25 | .. *0900 | .. | .. | *1030 | .. | .. | .. | .. | .. | .. | .. | 2 | |
| 26 | .. *0930 | .. | .. | *1000 | .. | .. | .. | .. | *1500 | .. | .. | 3 | |
| 27 | .. **1200 | .. | .. | *1500 | .. | .. | .. | .. | .. | .. | .. | 3 | |
| 28 | .. *1500 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | |
| 29 | .. *1000 | .. | .. | *1130 | .. | .. | .. | .. | .. | .. | .. | 2 | |
| 30 | .. **1500 | .. | .. | *1000 | .. | .. | .. | .. | .. | .. | *1530 | 4 | |
| 31 | .. *1000 | .. | .. | .. | .. | .. | .. | .. | .. | .. | .. | 1 | |

RESTOCKING MUGGER CROCODILE

The best size for release also requires discussion. It is possible with mugger crocodiles, for instance, to release individuals much smaller than the 1.1 m size used here. Singh (1976) reported on two mugger of 56 and

under all conditions throughout the country. There are a number of good reasons for selecting this size. There are also doubts that small mugger will show good survival at least in certain habitats as they will be unable to defend

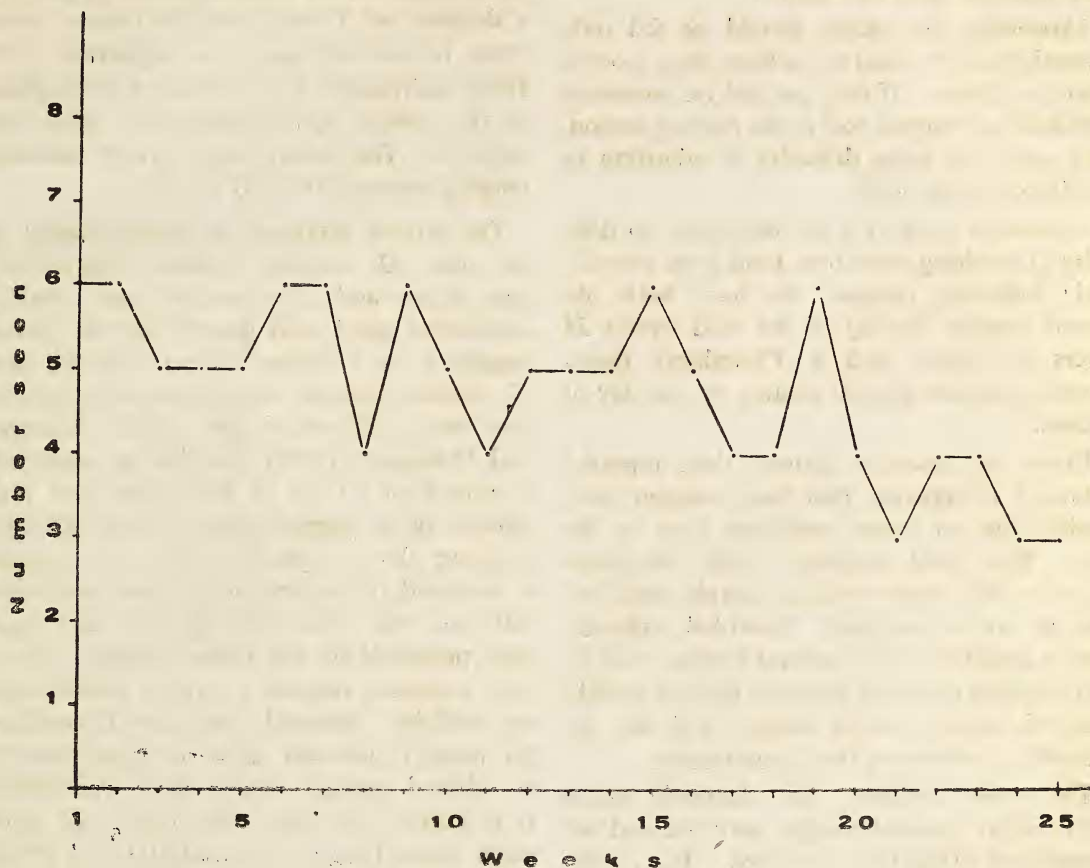


Fig. 3. Daily maxima for crocodile sightings plotted on a weekly basis for the period 29 September 1980 to 7th March 1981. The form of this plot does *not* indicate a falling trend in numbers observed. The apparent fall in February/March is due to the heat of the summer when the crocodiles remain mostly in the water making observation difficult. Furthermore, 7 individuals were seen on 17th May, 1981, a higher figure than that recorded since the study has commenced.

41 cm respectively, which escaped from their hatchling pool into the adjacent Mahanadi river (Orissa) during October 1975. Both survived and are still there today. The release sizes recommended here, of 1.0-1.2m, is that for which we feel the survival rate will be high

themselves from all predators. Burrow construction is also important in the mugger as a means of avoiding extremes of both heat and cold. Animals of below 1.2 m have not been observed digging burrows (B.C. Choudhury, unpubl. observ.). Further below 80 cm, it is